

Public Policies, Private Choices: Consumer Desire and the Practice of Energy Efficiency



Edison Electric Institute Bulletin, 1967

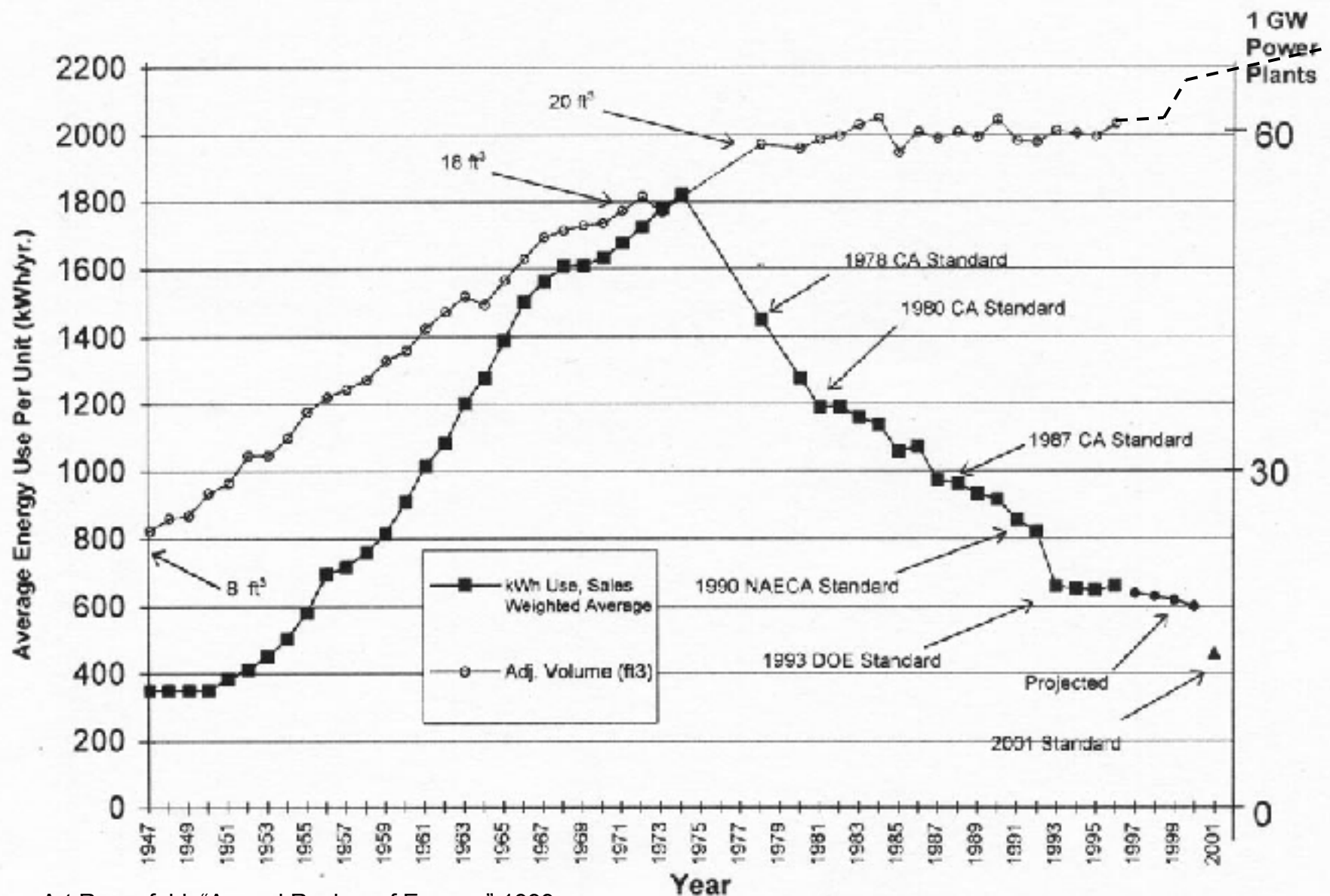


EETD Series, LBNL March 19, 2008 Reuben Deumling

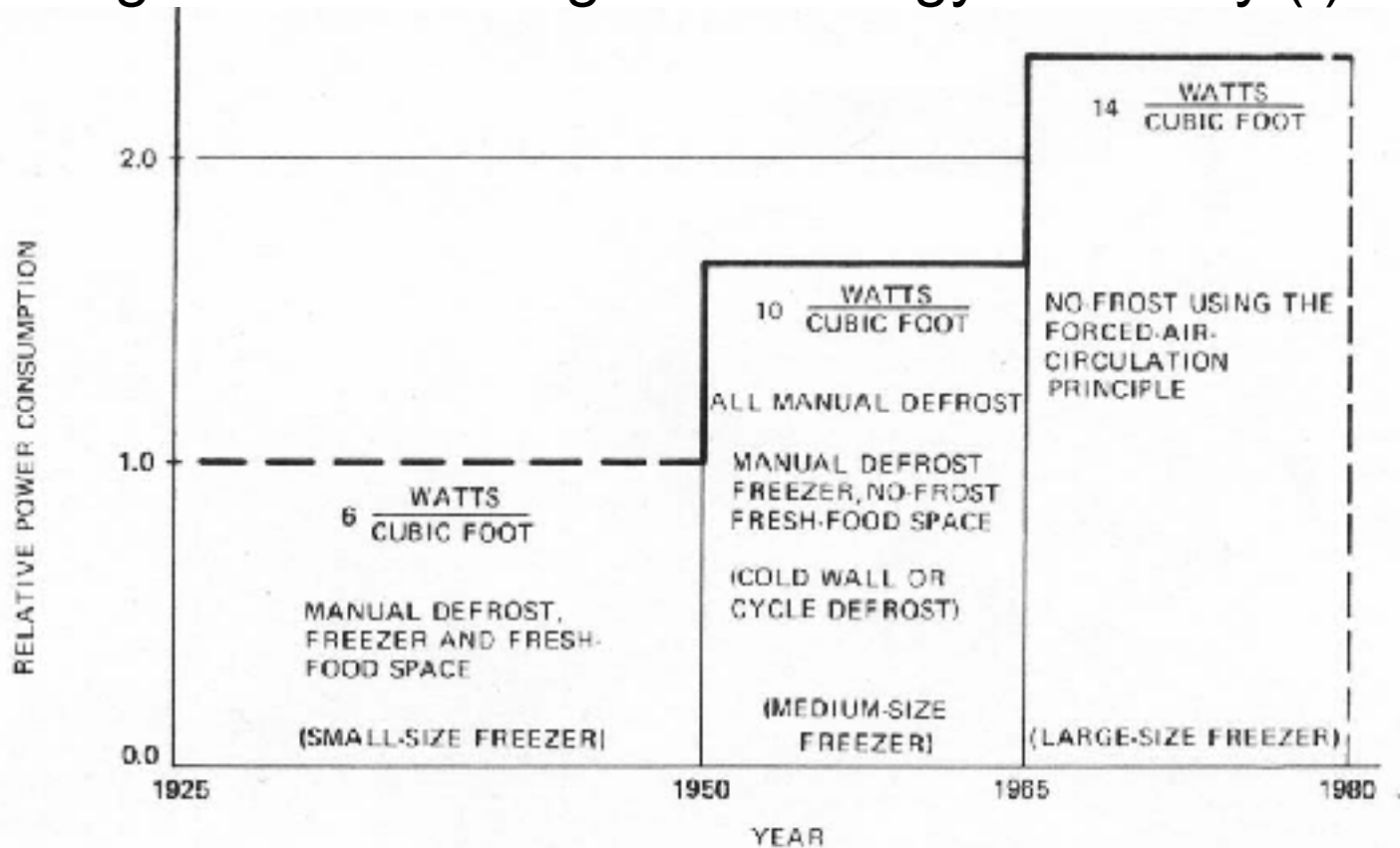
Outline:

1. Refrigerator energy efficiency: a short historical interrogation
 - +growth in per unit energy consumption
 - +energy efficiency vs. consumption
 - +dissecting refrigerator energy growth over time
2. Energy Guide labels, Consumer Reports refrigerator tests:
two close readings
3. Regulatory embrace of consumption as framework
 - + environmental responsibility and profitability
 - + social meanings of regulation
 - + waning of principled advice

The triumph of refrigerator energy efficiency standards: the rise and fall of average new refrigerator UEC



Explaining decline in refrigerator energy efficiency (I)



TYPICAL SIZES OF MACHINES, TOTAL CUBIC FEET

5 TO 10	8 TO 15	12 TO 24
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ESTIMATED UNCERTAINTY (STANDARD DEVIATION) WATTS/CUBIC FOOT

2.0	1.0	0.8
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Figure 1-3. Estimates of average power consumption of refrigerators.

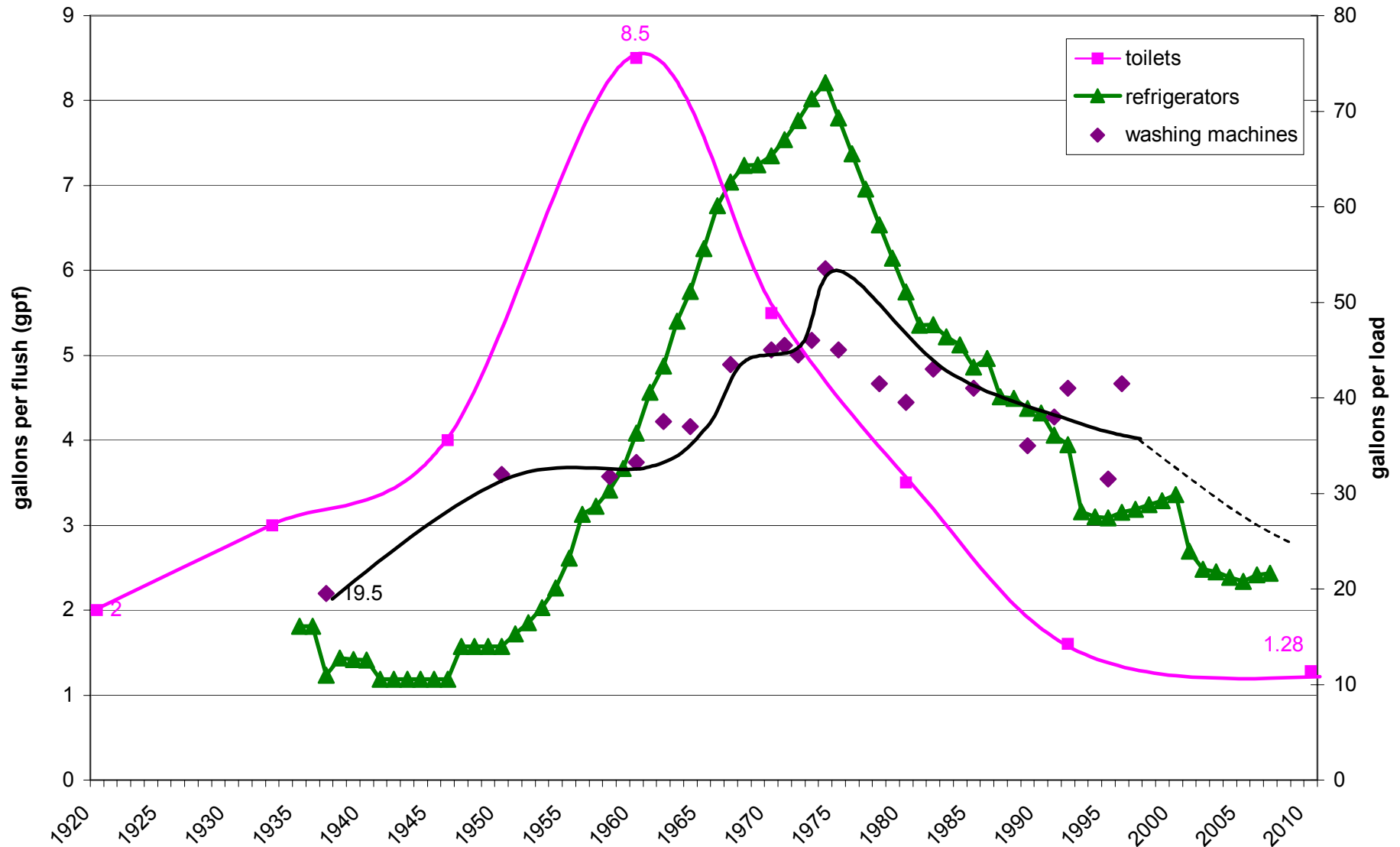
Explaining growth in refrigerator energy consumption (II)



“The electric utilities, through EEI and NEMA, are directing their sales efforts toward the sales of refrigerator-freezers and combos in order **to boost the kwh usage of refrigerators from the present 500 to the 1,300 kwh** that the new boxes draw. This means \$20 a year extra to the utility when a customer owns one of your deluxe refrigerator-freezers or combos.

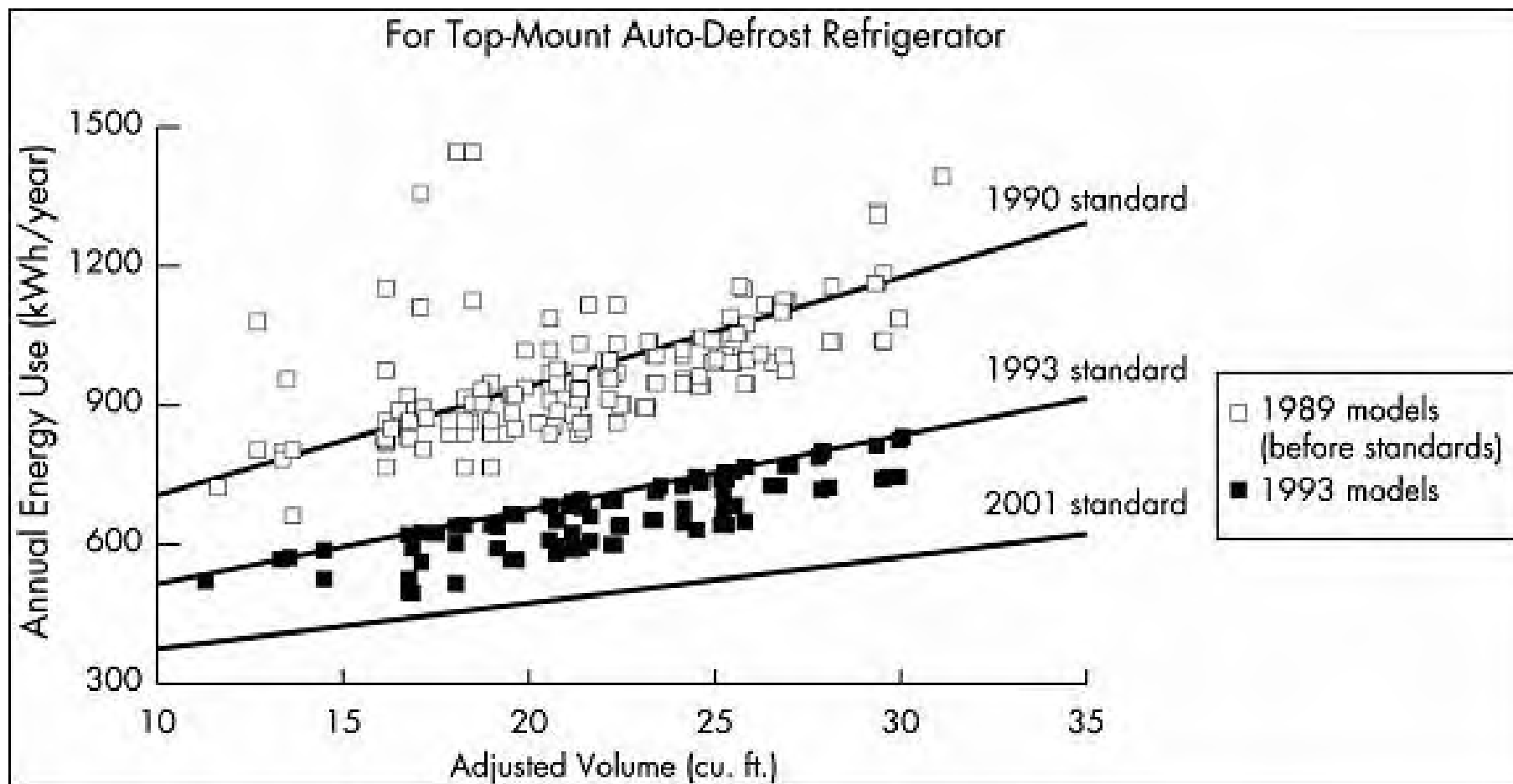
The Utilities not only want the extra load your refrigerator-freezers will provide, they are ready to spend millions of dollars to get it.”

Market barriers or mischief: inflection points for toilets, washing machines, and refrigerators in the US

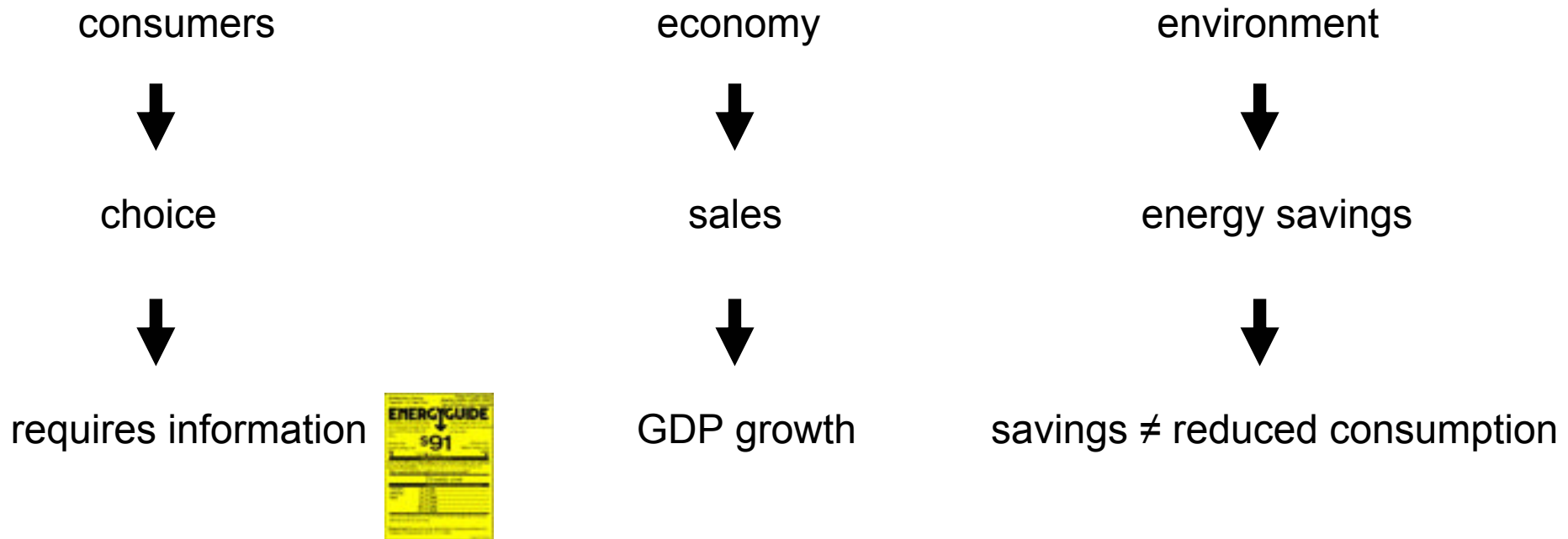


Sources: "History of Water Conservation in American Toilets," R Bruce Martin; Consumer Reports tests of washing machines

Refrigerator standards' effect on pool of available new Top-Freezer models

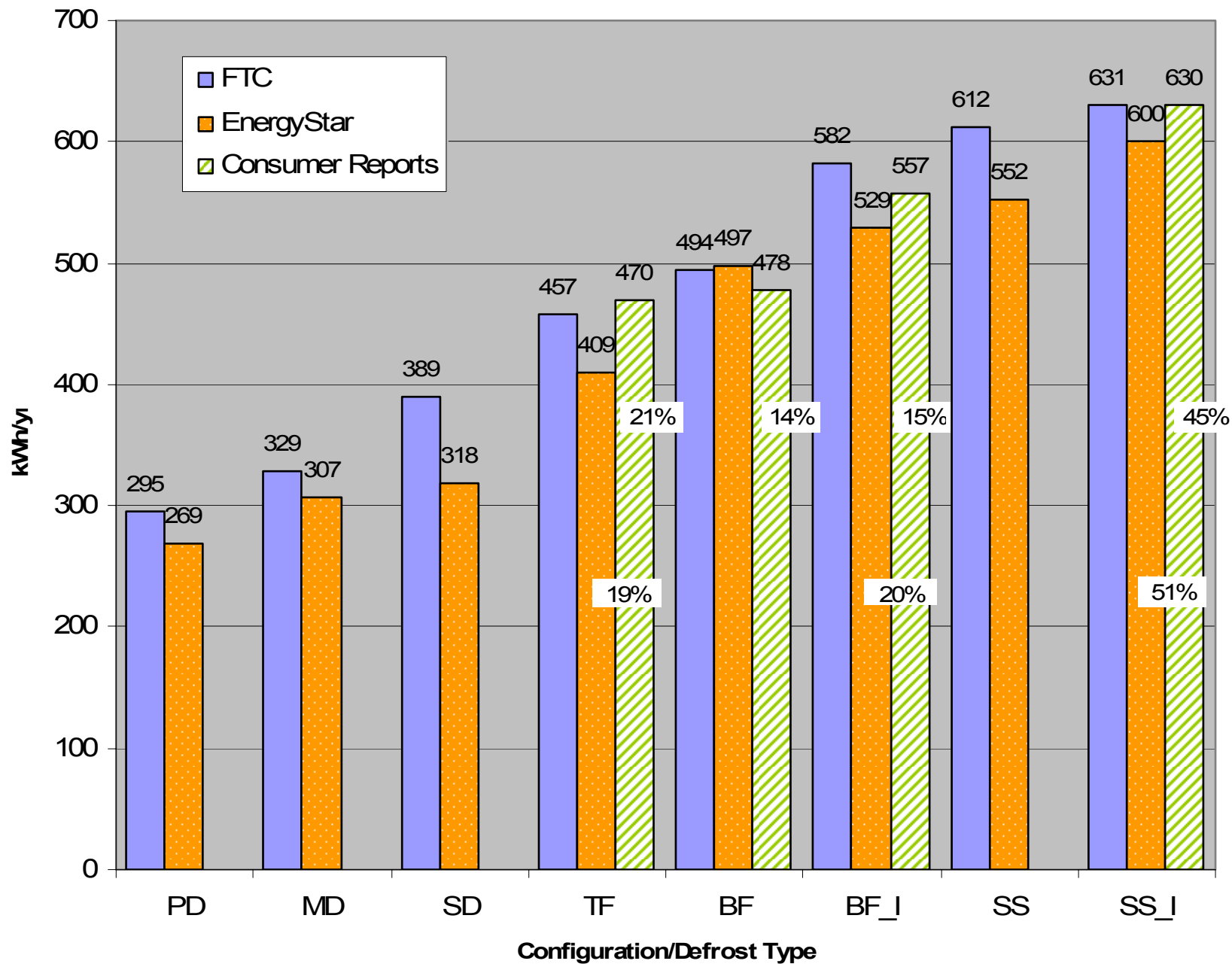


Refrigerator energy efficiency: win – win - win

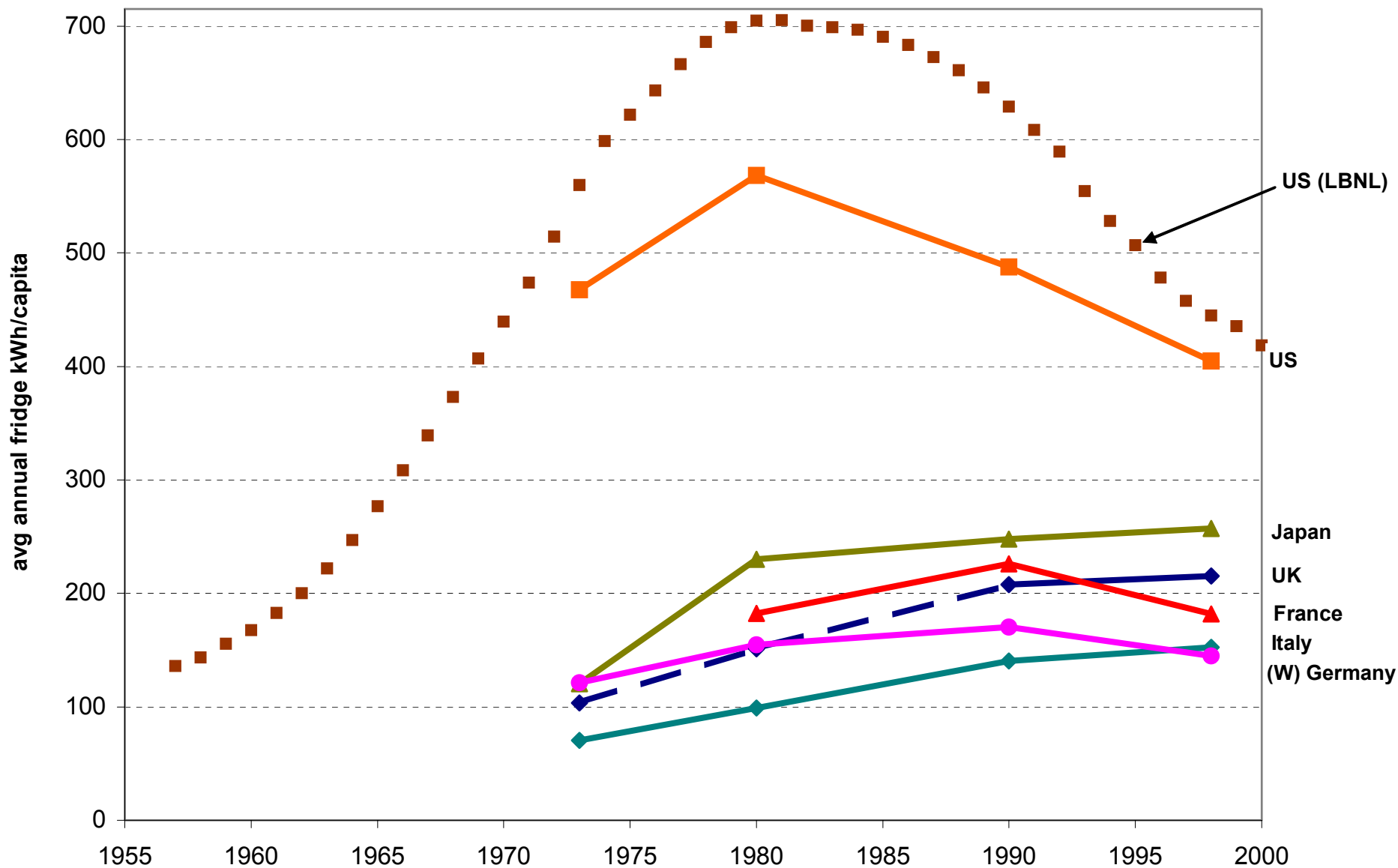


“As would be expected, the average base case energy consumption increased as size increased, and correspondingly, the **average energy savings generally increased as size increased**. It is interesting to note that **the greatest percent savings also occurs in the largest units** and the smallest percent savings occurs in the smallest units [...] the most efficient refrigerators being 23 cubic feet or greater, saving 33% beyond standards. The lowest efficiency models were smallest, 14-17 cubic feet, which saved 20% beyond standards.”

2007 Refrigerator Energy Consumption (>8.5 cu ft)

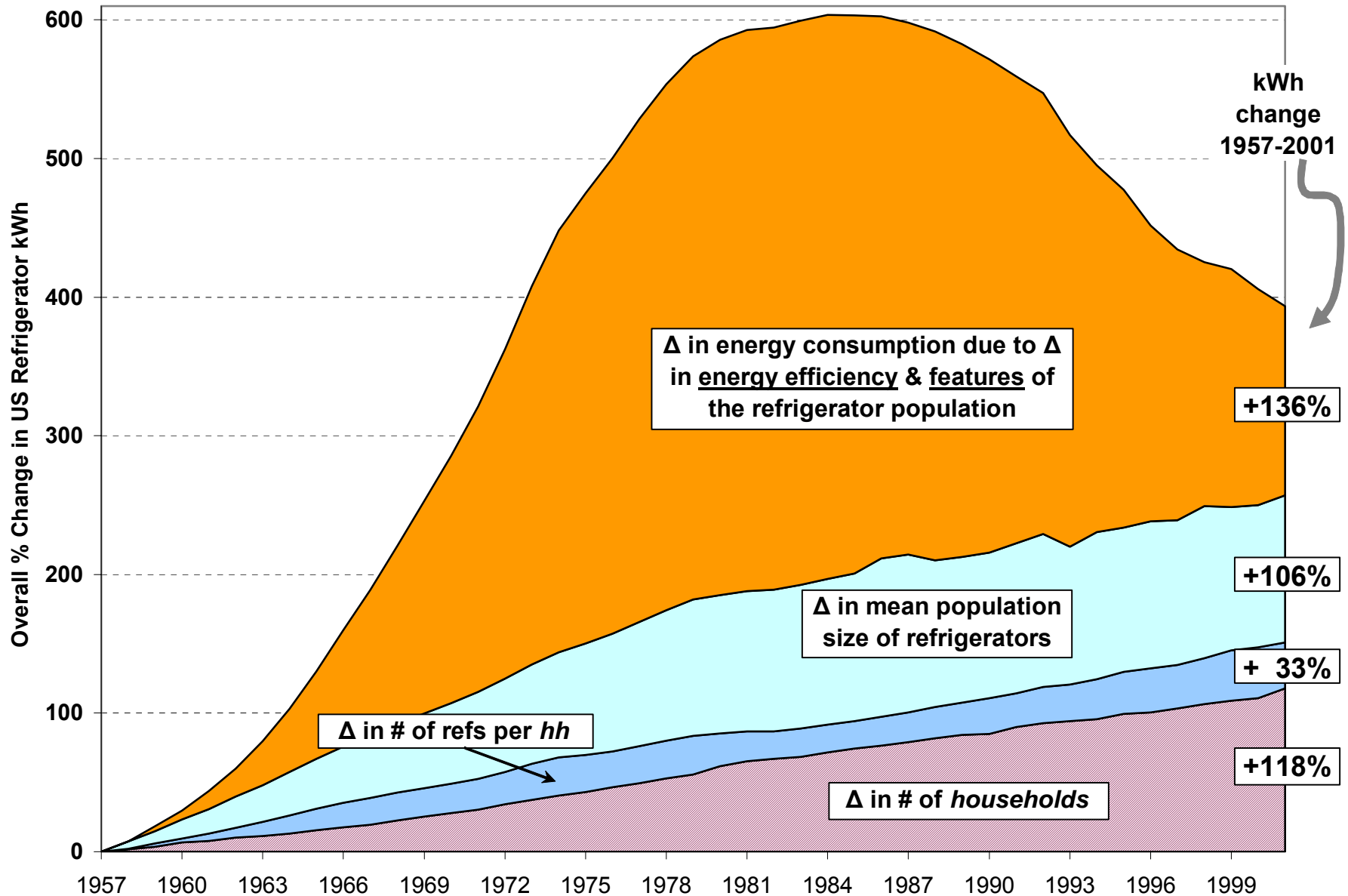


Trends in *per capita* Refrigerator energy consumption in six OECD countries

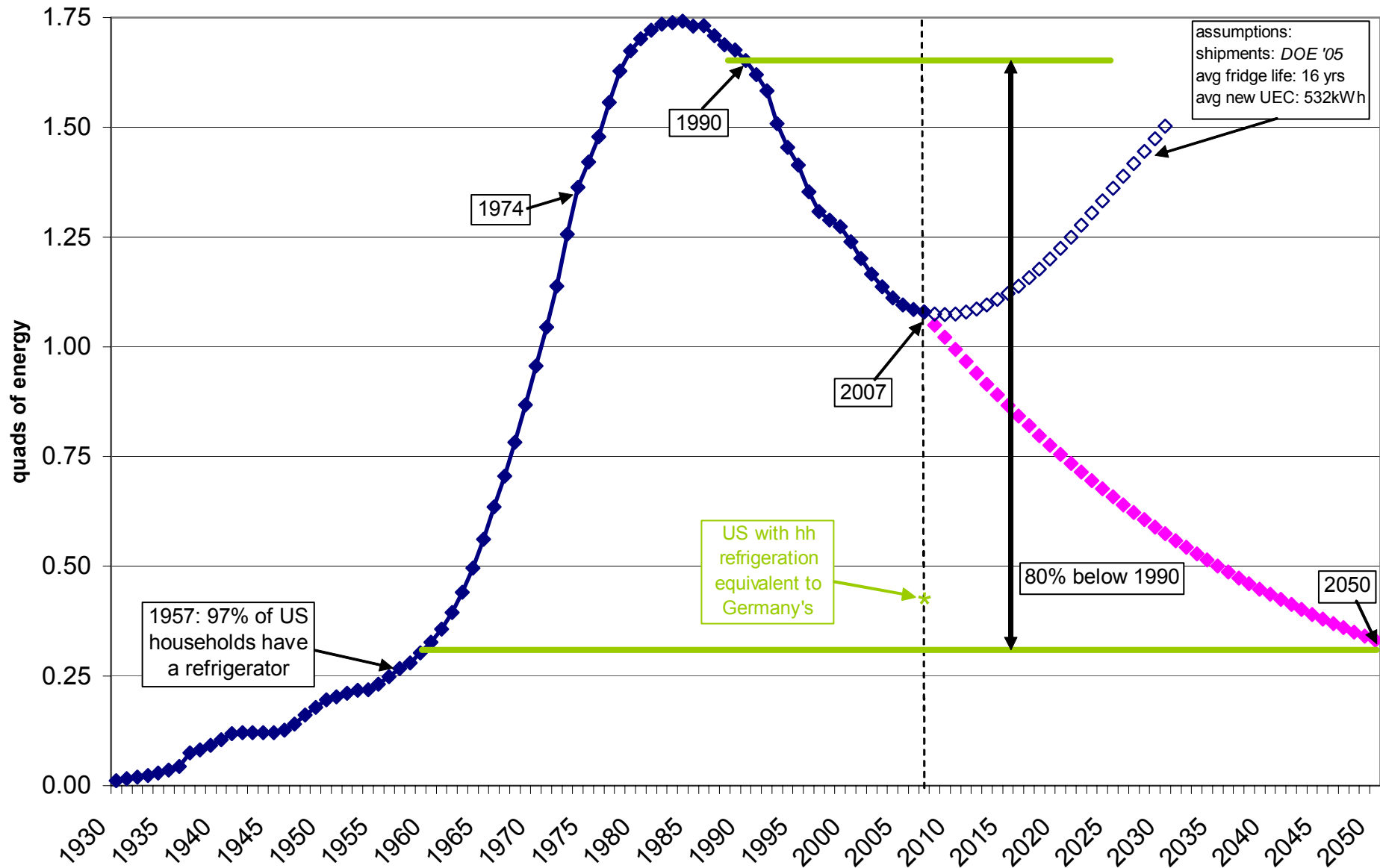


Refrigerator energy efficiency's legacy

Apportioning change in total U.S. refrigerator energy consumption (normalized to 1957)



Changes in Total US Refrigerator Energy: Past & Necessary to Comply with Executive Order S-3-05



2. Energy Guide & Consumer Reports: Information, choice, & desire

- Informational label (1980-present)
- Consumer test magazine(1938-present)

Table 5.2. Minimum Efficiency Standards for Residential Refrigerators

Type	Year Eff. (1)	Maximum UEC Equation (2)	Average Capacity (Adj. Vol.) (3)	Calculated UEC	Calc. EF (4)	Fraction of Sales (5)
MND	1990	$UEC = 16.3 * Capacity + 316$	5.0 cuft	398 k/Wh/yr	4.60	4.7%
PAD	1990	$UEC = 21.8 * Capacity + 425$	14.6 cuft	747 k/Wh/yr	7.13	5.6%
TAD	1990	$UEC = 23.5 * Capacity + 471$	20.6 cuft	956 k/Wh/yr	7.88	72.9%
SAD	1990	$UEC = 27.7 * Capacity + 488$	22.2 cuft	1243 k/Wh/yr	8.00	6.2%
BAD	1990	$UEC = 27.7 * Capacity + 488$	27.2 cuft	1243 k/Wh/yr	8.00	2.5%
TADI	1990	$UEC = 26.4 * Capacity + 535$	20.6 cuft	1079 k/Wh/yr	6.97	0.7%
SADI	1990	$UEC = 30.9 * Capacity + 547$	27.2 cuft	1389 k/Wh/yr	7.16	7.4%
Average (6)	1990	n/a	20.6 cuft	976 k/Wh/yr	7.71	100.0%
MND	1993	$UEC = 13.5 * Capacity + 295$	3.6 cuft	348 k/Wh/yr	3.78	13.0%
PAD	1993	$UEC = 10.4 * Capacity + 398$	14.6 cuft	550 k/Wh/yr	9.69	0.0%
TAD	1993	$UEC = 16.0 * Capacity + 355$	20.7 cuft	686 k/Wh/yr	11.01	66.4%
SAD	1993	$UEC = 11.8 * Capacity + 501$	27.5 cuft	826 k/Wh/yr	12.16	8.0%
BAD	1993	$UEC = 16.5 * Capacity + 367$	27.5 cuft	821 k/Wh/yr	12.23	1.1%
TADI	1993	$UEC = 17.6 * Capacity + 391$	20.7 cuft	755 k/Wh/yr	10.00	1.2%
SADI	1993	$UEC = 16.3 * Capacity + 527$	27.5 cuft	975 k/Wh/yr	10.29	10.4%
Average (6)	1993	n/a	19.8 cuft	686 k/Wh/yr	10.54	100.0%
MND	2001	$UEC = 19.9 * Capacity + 98$	3.6 cuft	170 k/Wh/yr	7.75	13.0%
PAD	2001	$UEC = 10.4 * Capacity + 398$	14.6 cuft	550 k/Wh/yr	9.69	0.0%
TAD	2001	$UEC = 9.8 * Capacity + 276$	20.7 cuft	479 k/Wh/yr	15.78	66.4%
SAD	2001	$UEC = 4.9 * Capacity + 508$	27.5 cuft	643 k/Wh/yr	15.62	8.0%
BAD	2001	$UEC = 4.6 * Capacity + 459$	27.5 cuft	586 k/Wh/yr	17.14	1.1%
TADI	2001	$UEC = 10.2 * Capacity + 356$	20.7 cuft	567 k/Wh/yr	13.32	1.2%
SADI	2001	$UEC = 10.1 * Capacity + 406$	27.5 cuft	684 k/Wh/yr	14.68	10.4%
Average (6)	2001	n/a	19.8 cuft	476 k/Wh/yr	15.21	100.0%

Energy Guide label: early conceptions of purpose

“Responsibility for the communication decisions on the energy labels was assigned to two agencies. The Federal Trade Commission was given responsibility for establishing the exact format of the labels. [...] Meanwhile, the Department of Energy was given responsibility for a consumer education (persuasion) program **to increase the importance of energy information in consumer decisions**. This activity is intended to complement the energy labeling program. Thus, while **the goal of the labeling program is clearly to reduce energy consumption**, the labels themselves are not expected to totally serve both the motivational and informational roles.” McNeill & Wilkie, 1979

“If energy information stimulates interest in energy efficient models, refrigerator buyers could respond in a combination of three major ways:

- By purchasing a manual rather than a frost-free defrost
- By shifting to a smaller size refrigerator that is generally more efficient
- By selecting the most efficient model within a particular size category”

Anderson & Claxton, 1982

Energy Guide label: evolution of official purpose

The purpose of the Energy Guide label is

“to **encourage** consumers to **comparison**-shop for energy-efficient household appliances. [...] the rule will permit consumers to compare the energy efficiency of competing appliances and to weigh this attribute against other product features in making their purchasing decisions. [...] the availability of this new information should **enhance** consumer **demand** for appliances that save energy.”

Federal Register 44 (1979)

“The label serves two important purposes. First, the detailed operating cost and energy consumption information on the label **allow** consumers to **compare** the total cost of competing models. Second, the label **aids consumers who are seeking** to buy high-efficiency products that reduce energy use and thus help the environment.” *Federal Register* 72 (2007)

Energy Guide labels assume and reinforce low priority consumers' place on energy when shopping for appliances

Refrigerator-Freezer
Capacity: 23 Cubic Feet

(Name of Corporation)
Model(s) ATIS03, ATIS04, ATIS07
Type of Defrost: Full Automatic

ENERGYGUIDE

Part of this label is based on a national average electric rate of 4.9¢ per kilowatt-hour.

Only models with 22.5 to 23.4 cubic feet are compared in the table.

\$91

Model with lowest energy cost: **\$68**

Model with highest energy cost: **\$132**

THIS MODEL

Your cost will vary depending on your local energy rate and how you use the product. (Energy use is based on U.S. Department of Energy tests.)

How much will this model cost you to run yearly?

Yearly cost	
Estimated yearly \$ cost shown below	
Cost per kilowatt-hour	\$36
4¢	\$73
6¢	\$109
8¢	\$145
10¢	\$182
12¢	\$218

Ask your salesperson or local utility for the energy rate (cost per kilowatt-hour) in your area.

Important: Removal of this label before installation of federal law (42 U.S.C. 6303).

1980

Based on standard U.S. Government tests.

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Top-Mounted Freezer
Without Through-The-Door-Ice Service

Capacity: 16.5 Cubic Feet

Compare the Energy Use of this Refrigerator with Others Before You Buy.

This model uses **460** kWh/year

Energy use (kWh/year) range of all similar models

Uses Least Energy: **414**

Uses Most Energy: **489**

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 5 to 18 in a color case and the same features are used in this table.

Refrigerators using more energy cost more to operate. This model's estimated yearly operating cost is:

\$38

Based on a 1980 U.S. Government national average cost of 8.2¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

1996

Consumer Reports champions energy efficiency

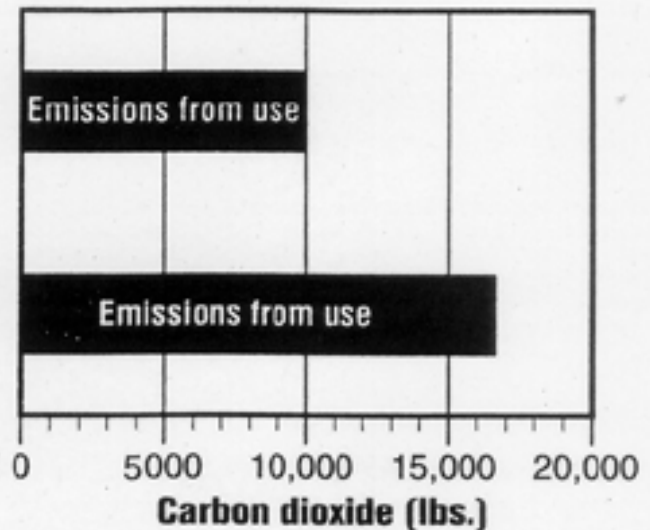
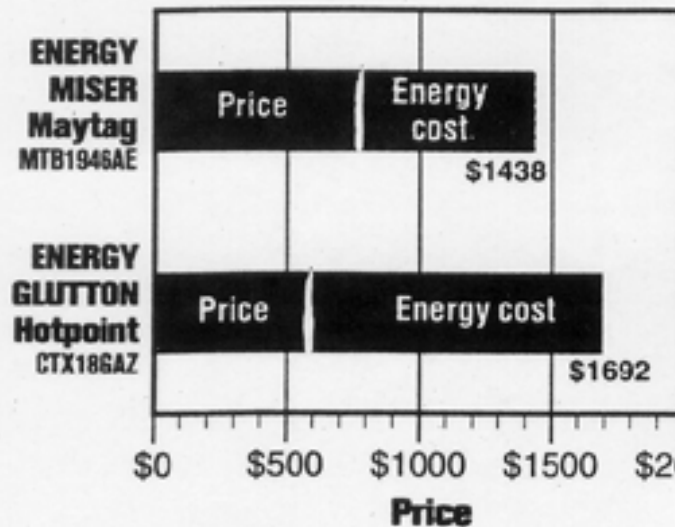


ENVIRONMENT

Why energy efficiency matters

A more-efficient model may cost less in the long run, despite being higher priced.

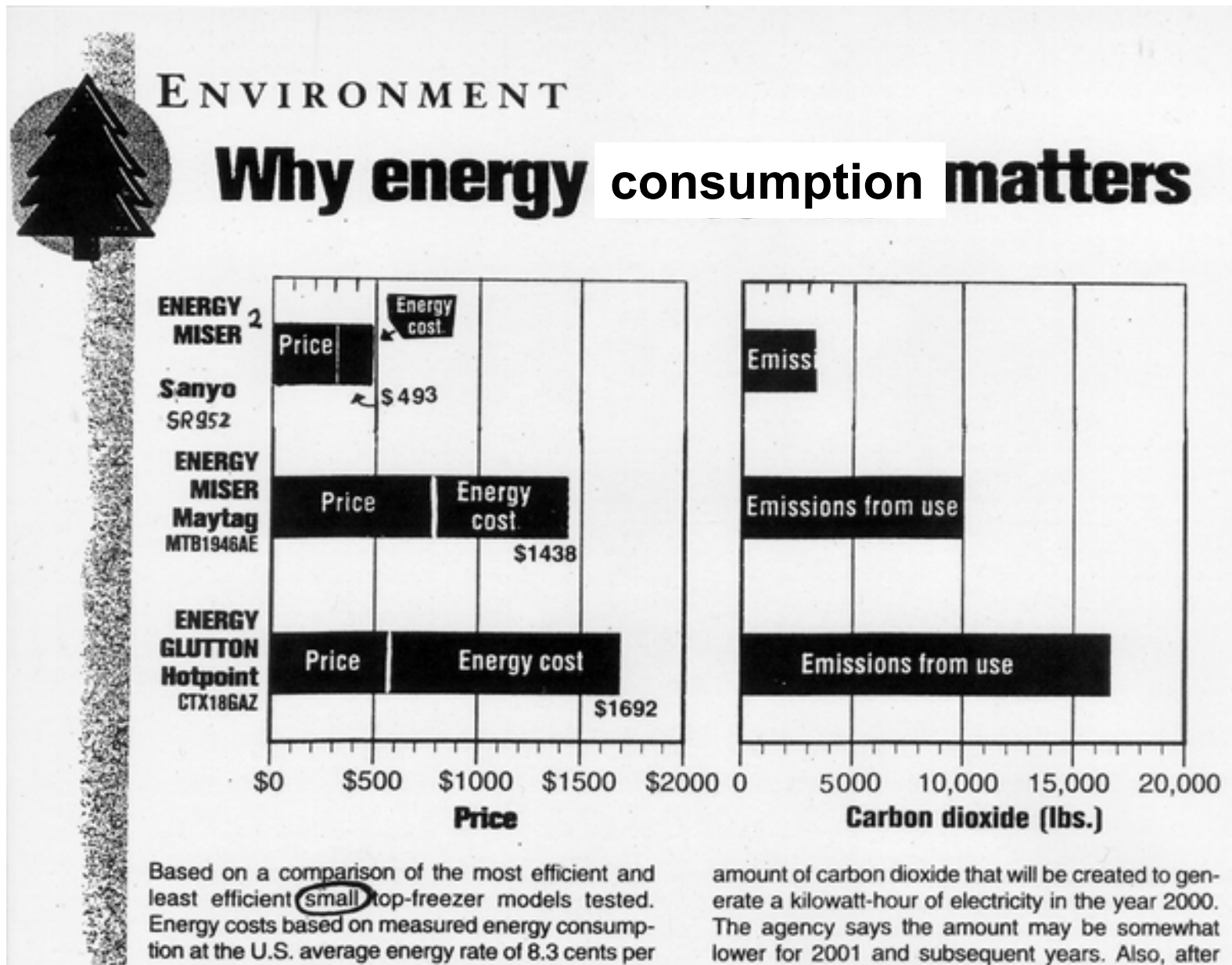
Its lower electricity use means less pollution from power plants.



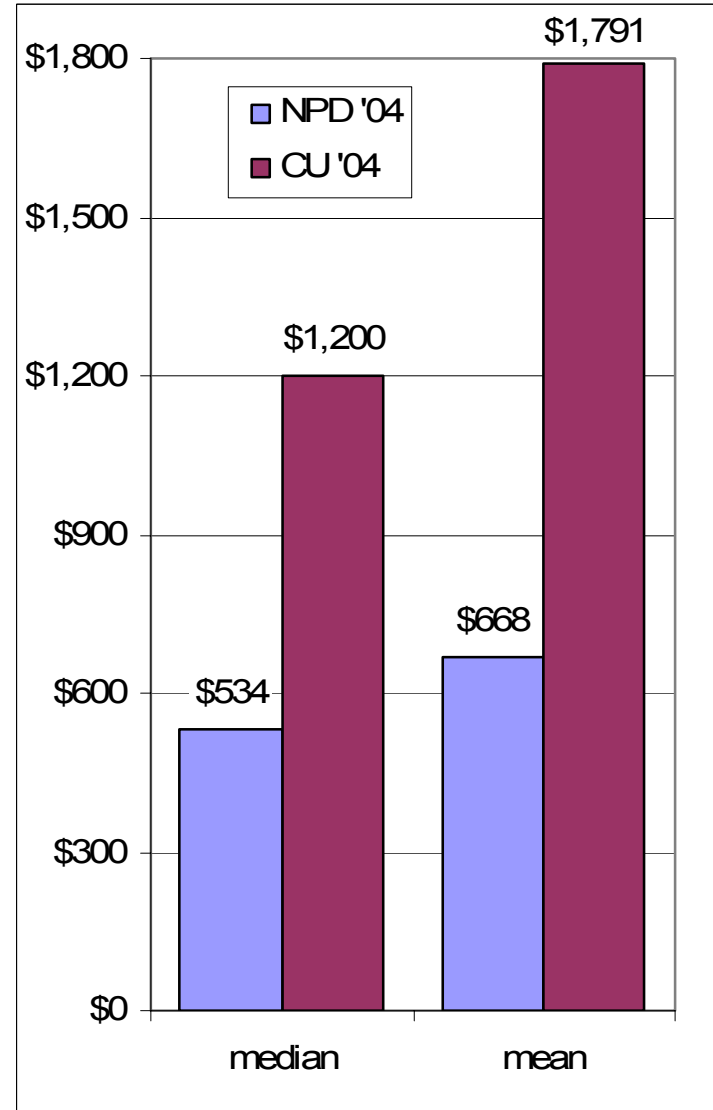
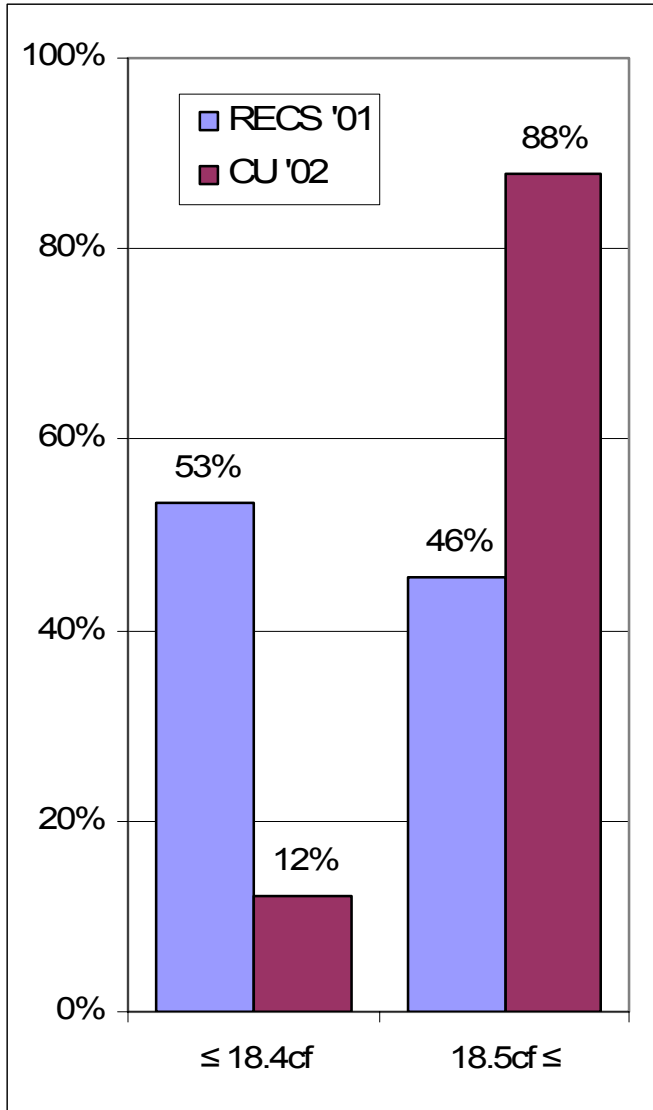
Based on a comparison of the most efficient and least efficient small top-freezer models tested. Energy costs based on measured energy consumption at the U.S. average energy rate of 8.3 cents per

amount of carbon dioxide that will be created to generate a kilowatt-hour of electricity in the year 2000. The agency says the amount may be somewhat lower for 2001 and subsequent years. Also, after

Consumer Reports obscures a more inclusive set of choices



Size and price comparisons of new refrigerators tested by CU and owned by US consumers



Consumer Reports, energy efficiency, and (inferred) consumer desire



“How Efficient? Refrigerators, one of the biggest energy-consuming appliances at home, have chalked up **impressive gains in efficiency**: Models sold nowadays work on about one-third less energy than those of a decade ago. The tested models averaged 1500 kilowatt-hours a year—only about the amount of electricity you’d use if you burned one 100-watt and one 75-watt bulb all the time.”



“How costly to run? Our estimates range from about \$29 for the *General Electric, Hotpoint, and Sears* cubes to \$42 for the intermediate *Avanti*. But low overall energy costs don’t necessarily mean high energy efficiency. The cubes are the cheapest to run in terms of actual electricity used, but they **consume the most energy per cubic foot of capacity**.”

	Interior (usable) volume cubic	kWh/yr	Price	kWh/ cu.ft.-yr	Price / cu. ft.
Amana SZD27K	16.7	1,464	\$1,490	88	\$89
GE TA6SL	5.2	379	\$285	73	\$55

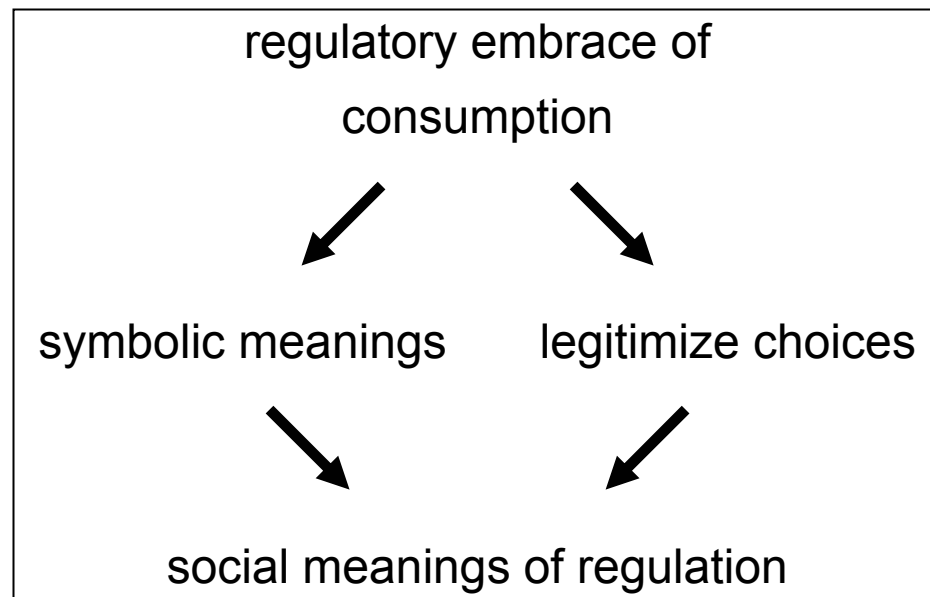
Source: 1991 CU tests, author’s calculations

Energy efficiency as stick with which to beat nonconforming perspectives and products

3. Regulatory embrace of consumption as framework



- 'Consumption' & 'EE' unequal parties to the negotiations
- EE allows industry to overcome marketing vulnerability in '70s
- EE fills government's need for symbolic action
- EE well suited to industry priorities



Consumer preferences: aligning ~~them~~ with energy efficiency with them



Consumer vs. citizen

experts 'know' what consumers desire

experts also know what is profitable

upscale version = \$\$

environmentally preferred version = \$\$



tempting to associate upscale with
environmental responsibility
(however obliquely)

“For retailers, Energy Star offers another sales pitch and another way to move those high-end products,” said Hewan Tomlinson, research associate at D&R International, Ltd., the environmental policy consulting firm that's implementing the program for the DOE. The hope, Tomlinson said, is to create consumer demand for energy-saving appliances with the help of retailers and utility rebates.” Dealerscope, 1997

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Star Power

Considering a kitchen makeover? Energy efficient, eco-friendly appliances abound.

Laura Daily

Call it the Energy Star era. No longer does conserving energy mean sacrificing quality, convenience, or appearance in the kitchen. Reduced kilowatt hours and in; water-guzzling is out. Even the stodgy old name-brand manufacturers are developing products to satisfy even the most ardent conservationist.

"The time to buy is now," says Jennifer Thome, a research associate with the American Council for an Energy-Efficient Economy (ACEEE) and co-author of the organization's *Consumer Guide to Home Energy Savings*. "In many cases the expenditure for a new appliance can more than make up for the cost in energy savings within a few years." What's more, she adds, as more states require that appliances be recycled, about 70 percent of old appliances will be spared the landfill—one reason that people were hesitant to upgrade.

When buying appliances, look for an Energy Star label, which indicates that a appliance exceeds federal efficiency standards. "Energy Star is a simple

Waning of principled advice



“That manufacturers and dealers regard the cheaper models largely as bait to bring the consumer into the store is apparent from almost any issue of the refrigerator trade magazines. Once in the store, they hope to ‘sell’ him on the higher-priced models.” *Consumer Reports*, 1940

"This [bundling features and size] tends to force the consumer who wants a big refrigerator to buy a model with expensive features which she may or may not want, but can't well avoid." *Consumer Reports*, 1952

imagine wanting more and getting it.

Space is so wary with the Samsung French Door Refrigerator. That's because it has more room. In fact, it has nearly a cubic foot more room than any other fridge in its category. And with the Samsung Twin Cooling System[®], all those groceries you bring home may stay fresher longer. With the Samsung French Door Refrigerator, it's not that hard to imagine. For more information, visit www.samsung.com/frenchdoor.



Original concept and execution by the designers of the new space and place.

Available at



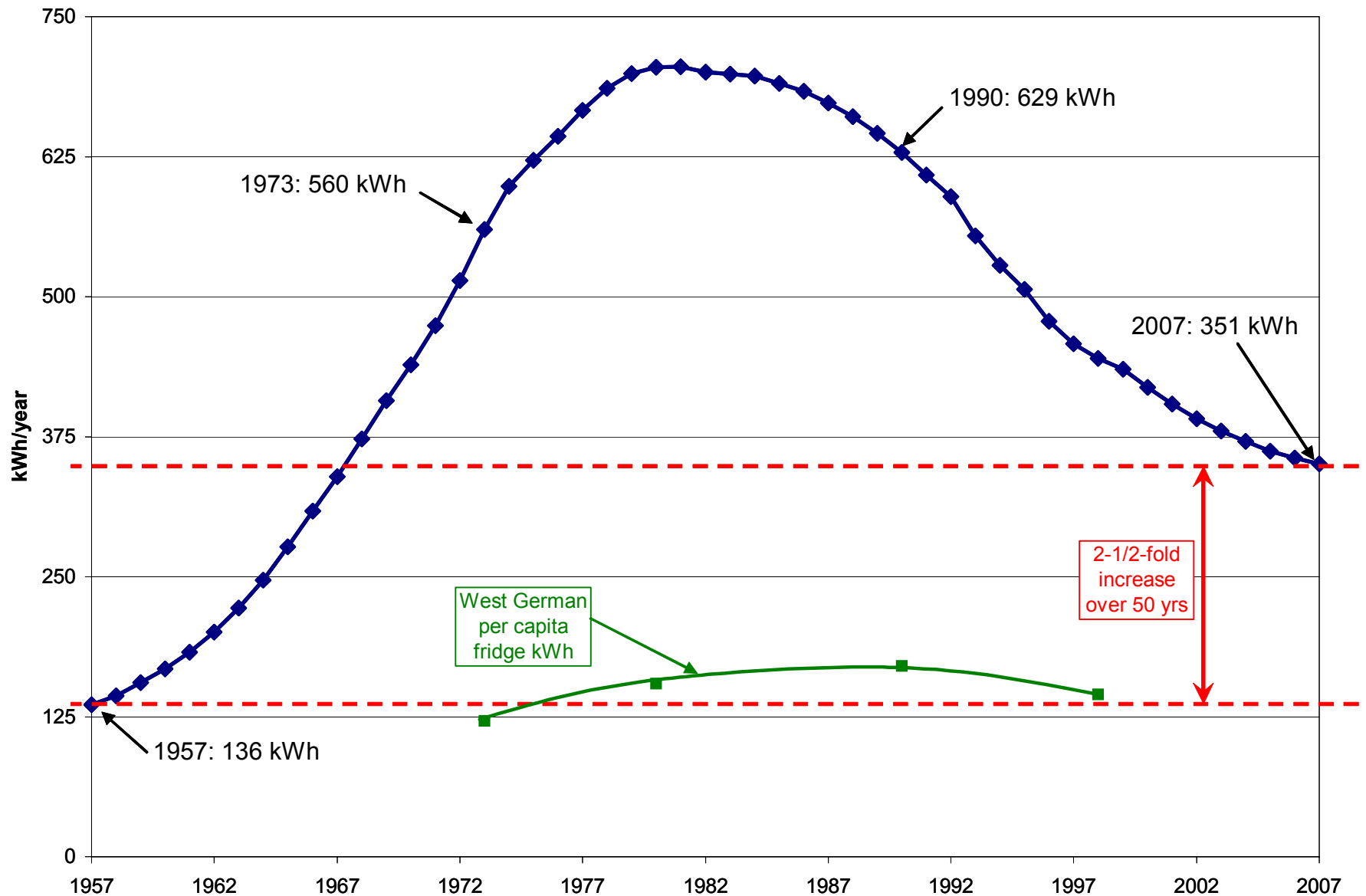
“You can never be too rich or have too much fridge space.” *Consumer Reports*, 2004

Conclusions

- Energy efficiency is a means not an end
- “Having our cake and eating it too” seductive but unhelpful in long run
- Pursuit of energy efficiency displaced & inverted rules of thumb; non-experts unable to understand or critique expert choices and decisions



US per capita refrigerator energy consumption over time



Energy consumption and energy efficiency of Manual Defrost refrigerators through time

